AD-A191 221 TIME RESOLVED SPECTROSCOPY FACILITY FOR THE STUDY OF NONLINEAR OPTICAL PR (U) CALIFORNIA UNIV SANTA BARBARA INST FOR POLYMERS AND ORGANIC S A J HEEGER 13 NOV 87 1/1

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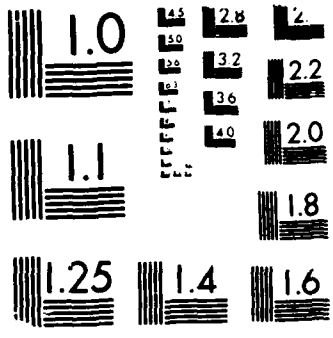

FINAL REPORT

N00014-86-G-0216

Time Resolved Spectroscopy Facility for the Study of Nonlinear Optical Properties of Semiconducting Polymers

Principal Investigator: Professor A. J. Heeger

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Our picosecond transient spectroscopy facility is in full operation with sub-picosecond pulses (autocorrelation pulses yield about 300 femtosecond pulse widith). Pump/probe measurements of photoinduced bleaching, four-wave mixing experiments and third-harmonic-generation experiments are underway.

The items purchased are outlined as follows:

ND-Yag Laser System Price includes: Laser Head, Power Supply, Frequency Doubler, Mode Locker System, Mode Locker Stabilizer, Pulse Compressor, Dye Laser and Accessories, Cavity Dumper, Power Supply and Electronic Chassis		$109,292
Autocorrelator		9,381
Oscilloscope and Accessories		18,503
Chopper and Accessories		2,338
Nonlinear Crystal for Difference Frequency Generation		2,041
Closed Circuit Camera System (Black and White)		3,219
Misc. Optical Components (i.e. Power Meter, Beam Steering, Lab Jack, X-Y Stage, Mirrors, Mirror Mounts, Prism, etc.)		3,976
	TOTAL	$148,750

RECENT RESEARCH RESULTS

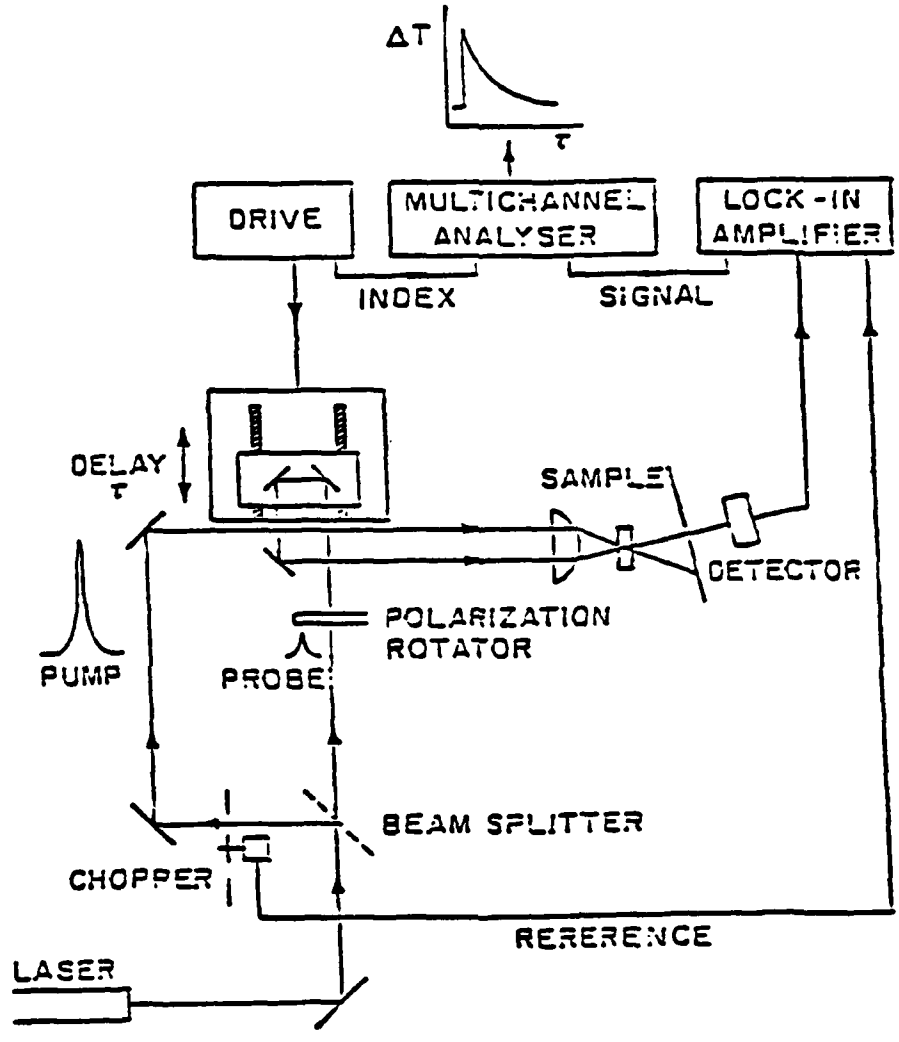
ANISOTROPY OF $\chi^{(3)}$ IN A DEGENERATE GROUND STATE POLYMER; TRANS-$(CH)_x$, M. Sinclair, D. Moses, and A.J. Heeger

We have measured the third order susceptibility associated with frequency tripling the fundamental of a Nd:YAG laser in various samples of polyacetylene. By measurement of the amount of third harmonic power reflected from a trans-polyacetylene sample relative to that from a sample of intrinsic silicon, we have determined the magnitude of $\chi_{\parallel}^{(3)}$ (all indices parallel to the chain direction) to be $\chi_{\parallel}^{(3)} = 9.5 \times 10^{-10}$ esu. Studies on

oriented samples indicate that $\chi_{\parallel}^{(3)}$ dominates all other components of the $\chi_{\parallel}^{(3)}$ tensor, consistent with the large nonlinear susceptibility being due to the conjugated π-electron backbone. We have also measured third harmonic generation in cis-rich polyacetylene samples. Here we find that the third harmonic power scales with the residual trans content; i.e. for a sample which ~15% trans, we find the measured $\chi^{(3)}$ to be 15% of the $\chi^{(3)}$ for the fully isomerized trans sample. Hence $\chi^{(3)}$ for the trans isomer is more than an order of magnitude larger than that of the cis isomer. This symmetry specific aspect of $\chi^{(3)}$ implies a mechanism which is sensitive to the existence of a degenerate ground state, as in trans-$(CH)_x$, consistent with the virtual generation of nonlinear solitons as the principal source of the large measured third order nonlinear optical coefficient of polyacetylene.

YAG laser

A schematic diagram of the operational facility is as follows:



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